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ABSTRACT

Free recall and cued recognition performance were studied in 53 field independent and 55 field dependent undergraduate education majors who were with or without structure at the time of learning and at the time of recall. Results indicated that field dependent learners recalled more of the textual material when provided with structure during both acquisition and recall, as well as when structure was not provided at all. Conversely, field independent learners recalled more of the textual material when structure was provided only at either acquisition or recall. This pattern of interaction was also apparent for multiple choice test performance and for students' indicated preference of learning technique. (Author/GDC)

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Cognitive Style: Effects of
Structure at Acquisition and Testing

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Abstract

This experiment examined the recall and recognition performance of 53 field-independent and 55 field-dependent learners who were with or without structure at the time of acquisition when they took notes from textual material, and/or at the time of recall. Field-dependent learners recalled more of the textual material when provided with structure during both acquisition and recall or when structure was not provided at all. Conversely, field-independent learners recalled more of the textual material when structure was singularly provided at either acquisition or recall. This pattern of interaction was also apparent for multiple-choice performance and for learning-technique preference as indicated by responses to a questionnaire.

Cognitive Style: Effects of Structure at Acquisition and Testing

Although considerable research has been conducted on learning techniques such as notetaking and review (see, for example, review papers by Hartley & Davies, 1976; Kiewra, 1985), few studies have considered individual processing differences among learners and the nature of the criterion task (Rohwer, 1984). Such investigations (which do not take these factors into consideration) are likely to provide implications that are either too general or misleading for certain learners under certain conditions.

Recent investigations of cognitive style (specifically field independence-dependence) with respect to study techniques have advanced knowledge about individual processing differences among learners and have provided more specific implications for instruction and for learning. From a processing perspective, field-independent learners actively abstract and cognitively restructure important information by breaking up an organized field into its basic elements and by providing structure for an ambiguous stimulus complex, whereas field-dependent learners display a more passive, spectator approach to learning by rigidly processing the stimulus structure as given (see Goodenough, 1976; Witkin, Moore, Goodenough, & Cox, 1977, for reviews).

These processing differences in combination with varied learning activities have produced differential but predicted effects on learning and relevant implications for instruction. Most commonly, researchers have either varied the structure of the acquisition task by manipulating the logical organization of the stimulus (e.g., Annis, 1979; Coward & Lang, 1979) or varied the degree of external structural support (e.g., Frank, 1984). These studies have generally found that field-dependent learners are helped by increased stimulus structure or by aids that initiate a personal

restructuring of the material, whereas field-independent learners, who more characteristically provide spontaneous organization to information, are not affected by such manipulations. From these findings, researchers have posited that external organizational devices such as advance organizers and notetaking handouts should facilitate achievement by field-dependent learners.

Although providing structure during acquisition has proven an effective technique, no study concerned with cognitive style and learning technique has simultaneously investigated the effects of manipulating structure at time of review or testing. Thus, the intention of the present study was to investigate the recall and recognition performance of field-independent and field-dependent learners who were provided structure solely at the time of acquisition or testing, on both occasions or on neither occasion. At acquisition, textual material was provided and notes were taken on an organizational matrix (structured) or in any desired manner (unstructured). Meanwhile, recall testing was also either cued (structured) or free (unstructured). Additionally, a multiple-choice test followed recall testing and provided an objective measure of learning not directly related to the imposed structure at acquisition and/or recall. Moreover, this additional test allowed the earlier recall tests to be viewed as additional opportunities for learners to learn or to review with or without structure prior to the multiple-choice test. It was anticipated that the findings of the present study would provide teachers with more specific implications regarding the utility of providing structure for notetaking and for review/testing for field-independent and field-dependent learners.

Method

Subjects

The Hidden Figures Test and the Advanced Vocabulary Test II (French, Ekstrom & Price, 1963) were administered to 136 education students enrolled in an undergraduate educational psychology course on human development. Reliabilities of .88 and .84 were obtained for the Hidden Figures Test (HFT) and the Advanced Vocabulary Test II (AVT), respectively. Performance on the HFT was used to classify students as either field-independent or field-dependent. From the original sample of 136 students, the 53 top scorers were identified as field-independent (HFT scores ≥ 14), and the 55 bottom scorers were identified as field-dependent (HFT scores ≤ 10); only these students participated further in the experiment. Because field independence is sometimes empirically linked to verbal intelligence (e.g., Goodenough & Karp, 1961), AVT scores served as a covariate in all analyses.

Design

Field-independent and field-dependent subjects were divided randomly into structured or unstructured notetaking conditions and again randomly assigned to take either cued or free recall exams. Hence, there were three independent factors, each with two levels: cognitive style (field independence, field dependence), notetaking (structured, unstructured), and recall (cued, free). This 2 x 2 x 2 factorial design resulted in eight treatment conditions.

Materials

All subjects received the same textual material that was to be learned in preparation for testing. The textual material contained a description of three methods of individualized instruction: Personalized System of

Instruction (PSI), Mastery Learning, and Programmed Instruction. Beneath each of these three instructional techniques, a number of facts were listed randomly, thereby obscuring the intended organization of the material. Actually, the three methods of instruction described in the textual material each subsumed subordinate ideas specifying general characteristics of instruction, advantages and disadvantages, teacher responsibilities, research evidence, and other information. In total, the textual material contained 98 factual ideas expressed in 1,106 words.

Subjects were provided with one of two sets of experimental instructions. All instructions explained the two stages of the experiment. It was specified that during stage one students would have 50 minutes to take notes on the textual material and that during stage two, five days later, students would have 20 minutes to review their own notes in preparation for a factual recall exam and a factual twenty-five item multiple-choice test. Specifically, subjects were directed during stage one to either record notes in any useful fashion on the attached three sheets of blank paper or on the attached organizational chart. Those provided with the chart for notetaking were told to determine if the textual ideas fit into one or more of the topical headings provided, and, if so, to briefly record the information in the appropriate cells of the organizational device.

The organizational matrix for structured notetaking was presented on three sheets of paper. The heading for each page corresponded to one of the three methods of individualized instruction (PSI, Mastery Learning, Programmed Instruction) discussed in the distributed textual material. Listed beneath the headings along the left hand margin were the subordinate topics (general characteristics of instruction, advantages and disadvantages,

teacher responsibilities, research evidence, and other information). A four centimeter by sixteen centimeter area for recording information was provided for each subordinate topic on each of the three pages. (An example is attached for the editor/reviewers.)

Subjects took one of two forms of a recall exam (free or cued), then a multiple-choice test. The free recall exam asked learners to recall as much information as possible about each of the three methods of individualized instruction. Three pages, each naming one of the methods of individualized instruction, were supplied. The cued recall exam was a duplication of the organizational matrix supplied for structured notetaking. Subjects administered this exam were also directed to recall as much information as possible and, additionally, to use the test matrix as a means for cueing and for organizing recalled knowledge. The multiple-choice test contained twenty-five factual items, with each item offering four alternatives.

At the conclusion of the experiment a four item questionnaire, using a five point Likert scale, was administered to determine students' perceptions about the difficulty of taking and reviewing notes, and the effectiveness of notes in preparing for recall and recognition exams.

Procedure

The experiment was conducted over three class periods. On Day 1 the HFT and AVT were administered in compliance with standardized procedures. Scores from the HFT were used to designate field-independent and field-dependent learners, who were then randomly assigned to notetaking and to recall conditions. On the second day, all subjects were provided with the unorganized textual material and with one of the two forms of instructions (which specified notetaking condition) and with corresponding materials for

notetaking. After reading the instructions, subjects were given 50 minutes to take notes on the textual material. Following this segment, all materials were collected and students were directed not to discuss the experiment. Five days later, on the final day of the experiment, students' notes were redistributed and students were allowed 20 minutes for review. Notes were then re-collected and 20 minutes were provided for students to complete one of the two forms of the recall test. Next, the students were given 20 minutes to complete the multiple-choice exam. Finally, students completed the post-experiment questionnaire.

Results and Discussion

Preliminary analyses of students' notes and exams revealed four subjects who did not comply with experimental instructions. The data obtained from these subjects were deleted, leaving a total of 104 participants whose data were analyzed.

To test the effects of cognitive style (field independence, field dependence), notetaking (structured, unstructured), and recall (cued, free) on performance effectiveness, while controlling for verbal aptitude, a three-factor analysis of covariance was conducted on recall and on recognition scores.

Performance Effectiveness

Recall Performance. Recall exams were blindly scored by three research assistants who tallied the number of discreet factual ideas that corresponded to a key of the 98 protocols designated by the authors. No distinctions were made in scoring free and cued exams. That is, for the cued exams responses received credit regardless of the subheading under which they were recorded. Average interrater reliability between the three raters was .86.

Results from the cued and free recall tests revealed a significant three-way interaction for cognitive style, notetaking, and recall, $F(1,103) = 5.16$, $p < .05$. None of the two-way interactions or main effects were significant. The cell means for the interaction are presented in Table 1. To aid interpretation, Figure 1 shows this interaction as 2 two-way interactions, one for each level of cognitive style. An examination of Figure 1 shows that field-independent learners who took notes using the organizational device performed better on the free than cued recall exam, whereas field-independent learners without structured notetaking performed best on the cued exam; conversely, field-dependent learners with notetaking structure did best on the cued exam, whereas those field-dependent students without structured notetaking did best on the free recall exam.

Insert Table 1 and Figure 1 about here

Recognition Performance. Results from the multiple-choice test ($M = 17.77$; $SD = 3.82$; $KR20 = .73$) revealed a main effect for cognitive style. Field-independent subjects scored significantly higher ($M = 19.38$) than did field-dependent subjects ($M = 17.24$), $F(1,103) = 6.27$, $p < .05$. Approaching significance ($p < .08$) were both the main effect of notetaking--structured notetakers ($M = 18.87$) achieved more than did unstructured notetakers ($M = 17.79$)--and the three-way interaction of cognitive style, notetaking, and recall. Although not significant, this interaction followed the same pattern as the one identified for recall performance. The cell means for this interaction are presented in Table 2.

Insert Table 2 about here

Questionnaire Results

Questionnaire items were also examined within the framework of a three-factor analysis of covariance. Questionnaire data generally supported test data. A significant three-way interaction between cognitive style, note-taking, and recall, $F(1,103) = 6.19$, $p < .05$, revealed that students' perceptions regarding effectiveness of the notetaking conditions were generally consistent with their patterns of performance on recall and recognition exams. In preparing for exams, field-independent learners perceived structured notetaking to be more effective if they took a free recall exam and unstructured notetaking to be more effective under cued recall conditions, whereas field-dependent learners taking either cued or free recall exams perceived structured notetaking to be more effective than unstructured notetaking. Not surprisingly, then, learners in general found structured notetaking to be an easier task than notetaking without an organizational device, $F(1,103) = 4.77$, $p < .05$. This finding is consistent with the generally higher achievement by structured notetakers, relative to unstructured notetakers, on the multiple-choice exam. Finally, field-dependent learners generally perceived the learning task as more difficult than did field-independent learners, $F(1,103) = 4.87$, $p < .05$, a finding consistent with the significantly higher scores by field-independent learners, relative to field-dependent learners, on the multiple-choice test.

Investigation of Notes

It would seem logical that differences in performance would have partially resulted from differences existing in the notes taken by field-independent and field-dependent learners. Consequently, the following dependent variables were analyzed within the framework of the three-factor ANOVA: number of idea units in notes, number of words in notes, and note-taking efficiency. The same procedure that was used for scoring protocols from the recall exam was used to score the number of idea units in the notes. The number of words was scored by simply counting all words recorded in notes. An efficiency index was calculated as the ratio of information units recorded to the number of words recorded (Howe, 1970). Interrater reliabilities among the three raters exceeded .90 for each of the three notetaking assessments.

The treatments produced no main or interactive effects on notetaking. No differences were found with respect to the number of recorded idea units, number of words, or number of words per idea unit. On the average, subjects did record in their notes about 59 idea units using a total of 447 words, or approximately eight words per idea unit. The finding that experimental manipulations failed to produce differential notetaking is not unusual. Notetaking behaviors have proved difficult to change in other studies as well (e.g., Bretzing & Kulhavy, 1979; Kiewra & Fletcher, 1985).

General Discussion

Most studies concerned with determining the relationship between cognitive style and learning technique have actively manipulated the type of acquisition technique students use or the degree of structure inherent within a designated task. Findings have rather consistently implied that

field-dependent learners benefit from structure whereas field-independent learners are not hindered by imposed structure. Such findings and interpretations, however, may have limited applicability because they do not consider the testing situation. This investigation varied structure at acquisition and at testing, thereby extending previous findings and offering more exact implications for instruction.

Field-dependent learners in the present study demonstrated what has been identified in studies examining memory and cognitive style (see Frank, 1983) as an encoding specificity tendency (Tulving & Osler, 1968). They performed best on recall exams when cues at acquisition and recall were matched (structured notetaking and cued recall, or unstructured notetaking and free recall). Difficulty at cognitively restructuring information makes an encoding specific task optimal for field-dependent learners, and inhibits their performance in unmatched recall situations (especially when cues are first introduced at the time of recall). Although field-dependent learners generally prefer extensive structure or cues (as indicated by their questionnaire responses), a failure to match cues at acquisition and testing debilitates their performance.

Field-independent learners, meanwhile, did not show an encoding specificity tendency but exactly the opposite effect. Previous research (Frank, 1983) has also indicated that field-independent learners do not show an encoding specificity tendency on memory-related tasks. Recall performance by field-independent learners in this study was most effective when acquisition and recall test cues were unmatched (structured notetaking and free recall, or unstructured notetaking and cued recall). This pattern was also apparent for these learners on the questionnaire where they indicated a

preference for either structured notetaking and free recall, or unstructured notetaking and cued recall. It may be that situations which provide both some structure and still allow for some degree of personal restructuring permit the field-independent learner's active and flexible processing style to operate at an optimal level.

These tendencies by field-independent and field-dependent learners were mirrored (to a lesser extent) on the subsequent recognition test. Apparently, the differential effects of these acquisition and recall manipulations are reliable and generalizable to a more objective test. In this case, the recall exams may also be viewed as another opportunity to learn or to review the information. If so, it seems that field-dependent learners may perform best on a multiple-choice test when cues at acquisition and "review" are matched, whereas field-independent learners will prosper most when cues, or structure is offered at only acquisition or only at "review."

Differences on recall and recognition exams were apparently unaffected by notetaking tendencies which were consistent for field-independent and field-dependent learners and for structured and unstructured notetakers, all of whom recorded a similar number of main ideas expressed in a similar number of words. The similarity of notes suggests that performance differences were attributable more to the internal processes of field-independent and field-dependent learners than to the type of notes recorded. Because notes were taken from textual material, however, judgement must be suspended regarding differences in notetaking from lectures with respect to cognitive style and structure.

From an instructional standpoint, instructors and designers should not be advised simply to provide structure during learning to compensate for

inactive processing modes among field-dependent learners without concern for the generally more self-directed field-independent learner. Instructors and designers must consider both acquisition and review/testing conditions with respect to cognitive style. It is recommended that field-dependent learners be provided with structure during acquisition to help them select and organize material, and with commensurate structure or cues at review/testing to help them recall encoded ideas. It is under these conditions that field-dependent learners perform best. If cues are not provided at acquisition, then providing cues at testing is less effective than providing no recall cues at all. Organizational matrices (like those incorporated here), instructor's notes, advance organizers and study guides are potential devices for focusing attention and for providing structure if exams subsequently reflect that highlighted information and its structure.

Field-independent learners may also benefit from these organizational devices under free recall conditions, where they are given an opportunity at recall to search actively through their personal network of associations. Under cued recall conditions, field-independent learners may perform best when instructors do not impose structure at acquisition and thus allow students an opportunity to restructure and encode the information personally.

This study represents an encouraging initial attempt to integrate the factors of cognitive style, learning technique, and criterion measure and to develop a more systematic and thorough approach for ultimately instructing different types of learners confronting various acquisition and testing conditions.

Author Notes

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Table 1

Mean Number of Ideas Recalled for Field-Independent and
Field-Dependent Learners in Structured or Unstructured
Notetaking and Recall Conditions.

		Structured Recall(Cued)	Unstructured Recall(Free)
Field-Independent	Structured Notetaking	26.69 (n=13)	30.07 (n=14)
	Unstructured Notetaking	29.62 (n=13)	27.31 (n=13)
Field-Dependent	Structured Notetaking	30.33 (n=12)	24.54 (n=13)
	Unstructured Notetaking	20.62 (n=13)	25.23 (n=13)

Note. The maximum mean number of ideas which could be recalled for any one cell is 98.

Table 2

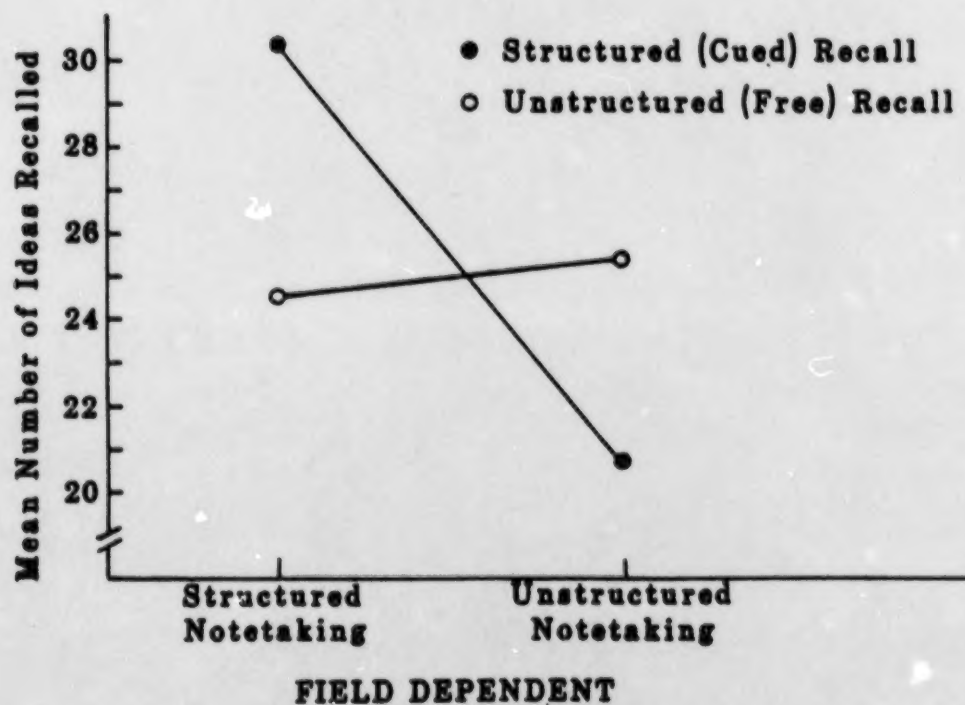
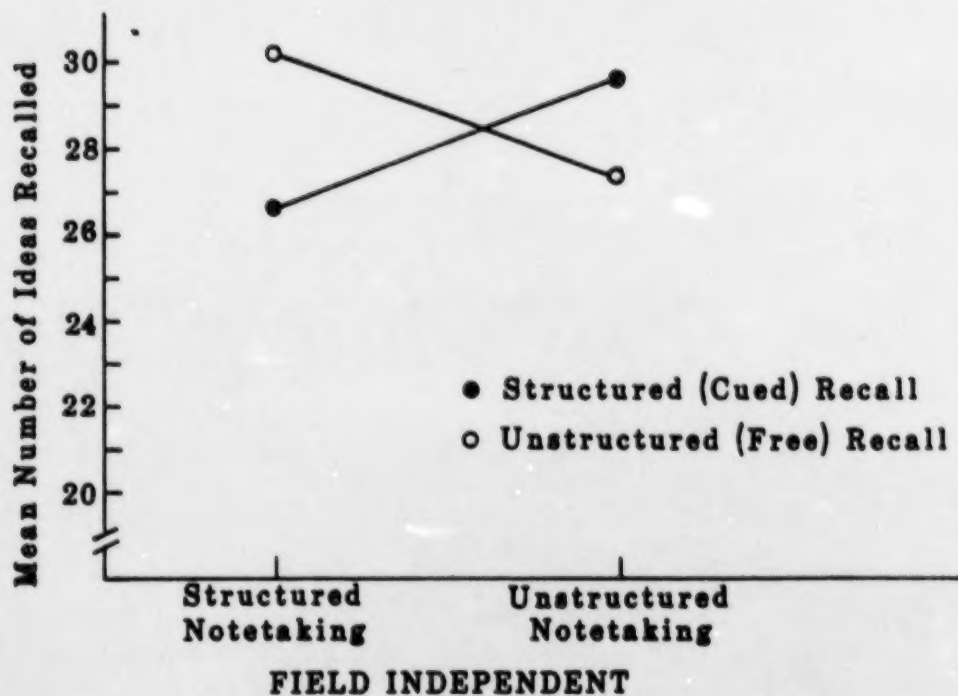
Mean Number of Items Correct on the Multiple-Choice Exam for
Field-Independent and Field-Dependent Learners in Structured
or Unstructured Notetaking and Recall Conditions

		Structured Recall(Cued)	Unstructured Recall(Free)
Field-Independent	Structured Notetaking	19.46 (n=13)	19.86 (n=14)
	Unstructured Notetaking	19.62 (n=13)	18.54 (n=13)
Field-Dependent	Structured Notetaking	19.25 (n=12)	16.85 (n=13)
	Unstructured Notetaking	15.69 (n=13)	17.31 (n=13)

Note. The maximum mean number of items which could be correct for any one cell is 25.

Figure Caption

Figure 1. Mean number of ideas recalled as a function of field independence-dependence, notetaking structure, and recall structure.



Organizational Chart
"Mastery Learning"

General
Characteristics
of
Instruction

Advantages:
General, teacher,
or student

Disadvantages:
General, teacher,
or student

Teacher
Responsibilities

Research
Evidence

Other
Information
